U.S. ARMY TECHNICAL CENTER FOR EXPLOSIVES SAFETY

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PROPELLANTS

Propellants are explosive compositions that are designed to deflagrate, producing large quantities of hot, gaseous products. Complete deflagration occurs in milliseconds and the pressure produced accelerates the projectile down the barrel of a weapon.

Most of the common artillery propellants can be divided into three categories: single, double, or triple-base propellants. Nitrocellulose is a major component of all three of these propellants. The stability of nitrocellulose is relatively poor. As nitrocellulose degrades, two chemical reactions occur. First, nitrocellulose releases nitrogen oxides. Second, the nitrogen oxides that are formed then attack the nitrocellulose. This reaction produces more nitrogen oxides and heat which accelerates the reaction rate. Nothing can be done to stop the formation of nitrogen oxides. However, stabilizers can be added to the propellant that bond with the nitrogen oxides and "absorb" them like a sponge before they can attack the nitrocellulose. This slows the rate of decomposition in propellants. It does not halt it as the stabilizer is eventually saturated with nitrogen oxides.

Based on this decomposition over time, propellants may be the most hazardous commodities stored on an installation. They become unstable at different rates. The rate of stabilizer depletion is affected by the chemical composition of the propellant and by the storage conditions of the propellant. Increased temperature causes an increase in propellant stabilizer deterioration. Propellants M10 and IMR, which are both single-based, have a history of auto-ignition. Over the past few decades, several storage structures containing these propellants have been damaged or destroyed due to the auto-ignition of the propellant.

As a result of these propellant accidents over the years, the Army has implemented a Propellant Stability Program (PSP). The known artillery propellants in the Army stockpile are monitored and tested for stability. The Industrial Operations Command maintains an on-line index called the Propellant Stability List (http://www.ioc.army.mil/ib/ibq/surv/gen/surv5.htm). Each installation should check this list against their records to assure that the lots of propellant in stock are serviceable.

If your installation has a lot of bulk propellant or propelling charge not found in the list, it may not be included in the PSP. You must check the most recent edition of the quarterly publication TB 9-1300-385, Munitions Restricted or Suspended.

For more detailed information on propellants, the history and background of the PSP, guidance regarding lots of propellant listed (or not listed) on the Propellant Stability List, and points of contact, check out the Propellant Management Guide. The U.S. Army Defense Ammunition Center, Logistics Review and Technical Assistance Office, publishes this guide. To receive a copy, contact Ms. Elena Graves, DSN 956-8052, or view it on the web at www.dac.army.mil.

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DEMOLITION GROUNDS -- A QUANTITY DISTANCE (QD) NIGHTMARE? THE BURIED EXPLOSION MODULE MAY BE YOUR ANSWER!

Demolition grounds are where we detonate munitions to get rid of them. Some people call them explosives ordnance disposal (EOD) ranges. Others call them open detonation grounds. No matter – safety wise, we don't want to injure anybody as we go about our work.

About 11 years ago, the Department of Defense Explosives Safety Board (DDESB) put out QD rules for demolition grounds. The rules give distances for blast and fragments. Many of you are familiar with these rules – but here's a snapshot:

- The blast distance is $328W^{1/3}$ (328 times the cube root of the net explosives weight).

- The fragment distance is 2500 or 4000 feet (depending on the size of the munition). Most of our demo grounds blow the bigger items and need the 4000 feet.

Some installations are having a heck of a time trying to meet this QD. Many of our demolition grounds were originally built with a clear zone of about 2400 feet, not enough distance by today's standards.

As a result, many installations have had to limit their demolition ground operations to comply. Some installations have had to shut down pits that don't have enough distance. Other installations have had to reduce the size of each demo shot.

The same DOD 6055.9-Std that gives us this QD also gives us a way out! The standard states "…measures taken to suppress blast and/or fragment effects may be used to reduce the distance".

What "measures" are they talking about? The main one is earth cover (also knows as tamping). Earth cover controls blast and fragments. And the thing is, we've been using earth cover for years!

So what's the problem? The problem is, we can't prove to DDESB that our earth cover is doing the job! Why do we need to prove this to them? Because they inspect our installations and tell us our demo range doesn't meet their QD!

So, we then submit a site plan. The site plan must provide to DDESB that our earth cover is doing the job. Simply telling DDESB that "We've used earth cover for years and never had a problem," won't work. They need proof. There are only two ways to do this:

a. Go out and collect fragments and take blast measurements to show that your clear zone is adequate with the shot sizes and earth cover you're using. Put the results of these tests in the site plan. Unfortunately, this testing is expensive and beyond the capabilities of most of our installations.

b. Prove on paper that the earth cover is doing the job.

As far as proving it on paper goes, this has two aspects: you have to prove it for blast and you have to prove it for fragments.

For blast, it's a no brainer. Simply go to table 5-8 in DA Pamphlet 385-64, 28 Nov 97, Ammunition and Explosives Safety Standards. This table is based on a DDESB approved program that predicts how earth cover reduces blast.

For fragments, it's more difficult. Until recently, we didn't have a computer program to predict how earth cover reduces fragment range. Now we do!

This new program is called the "Buried Explosion Module (BEM)" and DDESB has approved it. BEM analyzes the effect of earth cover on the range of both fragments and "crater ejecta". Crater ejecta refer to big clumps of dirt and rocks that are thrown out from the detonation. And believe me, dirt clods can kill. Just a few years ago, a soldier was watching his cratering charge go off and a big dirt clod killed him.

Here are some examples of how BEM works:

Let's say you're blowing 500 lb. shots of 155mm HE projectiles and you're using 5 feet of earth cover. BEM will tell you how far the fragments and crater ejecta will go.

Or this – say you want to blow 155mm projectiles. Your demo ground has a clear zone of 2500 feet. BEM will tell you how many projectiles you can put in each shot and how much earth cover to use.

And now the catch….

- BEM is too complicated for the average person to use.

- You'll have to pay the Corps of Engineers (CE) to run BEM for you.

If you give the CE the type of munition you are blowing, they can give you a table that relates net explosives weight and depth of earth cover to fragment and crater ejecta range. Dr. Crull at the CE tells me that applying BEM to a single munition type can run between $200 and $1000 – if the engineering drawings are readily available; more, if they are not. But if it can help you revive some pits that you had to shut down, or allow you to blow more per shot, it could save you money.

If you think BEM might help you, give Dr. Michelle Crull a call at 256-895-1653 or e-mail her at Michelle.M.Crull@hnd01.usace.army.mil.

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ACCIDENT REVIEW

SIMULATORS ARE FOR REAL

Realism is a factor units should build into every training scenario. To achieve this objective, units may employ the use of pyrotechnics to create an ambient similar to the one expected in combat. However, sometimes units forget that pyrotechnic use requires trained individuals. In preparation for any training, units should incorporate the use of risk management to help conduct operations in a safe manner. This level of detail was overlooked by a platoon leader that not knowing how to employ a simulator device decided to attempt to make it work and in the process sustained serious injuries.

Background

An artillery unit was in the field preparing for a battalion level training exercise. As part of its scenario, the battalion decided to include an aggressor force to evaluate the various sections reacting to an attack. The aggressor OIC was identified and he in turn detailed various soldiers from the unit to be part of this group.

In preparation for the event, the battalion had requested blank ammunition and pyrotechnics that included simulators to support the aggressor force. As the exercise was about to start, the aggressor OIC arrived at the field ammunition site to pick up the ammunition assigned to the aggressor force. One of the items provided to the OIC was a Simulator, Flash Artillery, M110. The aggressor OIC, not sure on how to use the simulator, decided not to accept the simulator. The ammunition platoon OIC was then asked if he knew how to use the simulator and he replied that he didn't.

It is suspected that this action sparked the curiosity of the ammunition platoon OIC who decided to ask around if anyone knew how to employ the simulator. After getting various responses from "I don't know" to "I think it uses gasoline" to "It needs a battery", none of them conclusive, the ammunition platoon OIC decided to attempt and figure out how to employ the simulator.

Accident

Since no one around the site knew how to employ the simulator, it was assumed that it acted like another pyrotechnic device, the Simulator Projectile Ground Burst, M115A2. The M115A2 simulator has a pull cord that once activated provides a whistle sound and a delay effect that allows the user to throw the item prior to its detonation. Since the ammunition platoon OIC had heard from soldiers around that a battery was needed to activate the simulator, he borrowed a battery from the ammunition platoon sergeant and proceeded to attempt and make the device work. When the ammunition OIC connected the lead wires to the simulator, it instantly detonated at a short distance from his body causing serious injuries to his face and lacerations to his body.

Circumstances

The circumstances that lead to this accident were a result of individual, leadership, and training failure. These failures were the result of various factors, one of them overconfidence on the part of the ammunition platoon OIC.

Individual Failure. The ammunition platoon OIC knowing that he was not trained on the use of this particular simulator decided to attempt to make it work. Even after having received a negative response from the soldiers around him on its use, he was sure he could figure out the employment of the simulator.

As the ammunition platoon OIC, he should have known that the Simulator, Flash Artillery, M110 does not have an audible sound or a delayed effect and that once current is applied, it will detonate instantly. A reference on how to properly employ the simulator should have been present in case no one was familiar on how to operate this device.

Leader Failure. No one at the site decided to make an on-the-spot correction to prevent this unsafe act. All soldiers around the area knew the ammunition platoon OIC intended to make the device work and that he did not know how to use it; but no one took any action to prevent it. The aggressor OIC, the ammunition platoon sergeant, and others in the area did not take corrective action to prevent this accident from happening.

The battalion had requested the device, but no one was familiar on how to use it. As per TM 9-1370-207-10, Mar 91, Pyrotechnic Simulators – Operators Manual, this device requires that gasoline be added to the simulator prior to its employment; that at least a 50-yard safety zone be established; and primarily that it is not intended for use while holding in the hands. Luckily in this case, the simulator did not have any gasoline in it, but the blast and fragment effects caused serious injuries to the platoon leader. Leaders failed to ensure that someone knew how to use the simulator they had requested.

Training Failure. The battalion did not have any trained soldiers on how to properly employ pyrotechnics. As per DA Pam 385-64, paragraph 2-5, 28 Nov 97, Ammunition and Explosives Safety Standards, munitions and/or explosives will be handled only by trained personnel who understand the hazards and risks involved in the oper ation. Leaders did not ensure that all safety precautions for the employment of pyrotechnic devices were followed.

Conclusion

The bottom line to this accident is that it happened as a result of poor judgment on the part of the ammunition platoon OIC. His overconfidence and the overconfidence of others in his ability allowed him to conduct this unsafe act. Had the leaders and soldiers around him made an on-the-spot correction, this accident would not have happened.

Leaders at all levels must encourage the use of risk management to ensure that all possible hazards are recognized and that control measures are implemented to minimize their risk. Had a risk assessment been done on this operation, it would have been recognized that no one knew how to employ the simulator and that the improper use of pyrotechnics can cause serious injuries or death.

The result of this tragic event left the ammunition platoon OIC with a possible permanent injury to his right eye. Leaders and soldiers should be reminded of the dangers posed by the improper use of ammunition items. Always remember that simulators are for real.

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ARTILLERY SIMULATOR (1370-L596) PERMANENTLY SUSPENDED FROM ISSUE AND USE!

Recently, Notice of Ammunition Restriction (NAR) 00-0030 was issued advising that **all lots of 1370-L596, Simulator, Flash Artillery M110, are PERMANENTLY SUSPENDED FROM ISSUE AND USE (PSIU) and assigned Condition Code "H".**

The 1370-L596, Simulator, Flash Artillery, M110, recently identified as being associated with several explosives accidents and personnel injury, has been deleted from the list of simulators authorized for training use. Headquarters, Department of the Army (HQDA), Office of the Deputy Chief of Staff for Logistics

(ODCSLOG), Army Training, has identified and authorized use of the 1370-L594, Simulator, Projectile Ground Burst, M115, in lieu of the M110 for training purposes.

Units possessing any of the suspended 1370-L596 artillery simulators should expeditiously turn them into their servicing Ammunition Supply Point (ASP).

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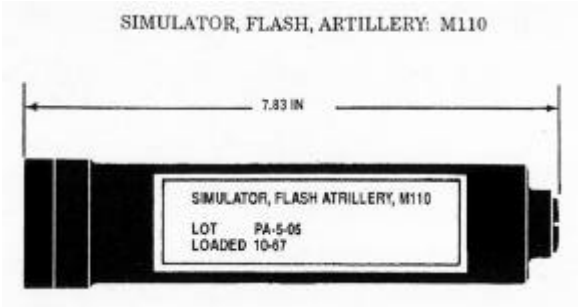
KNOW YOUR SIMULATORS!



WARNING
As indicated in the previous article, the M110 is not to be used.

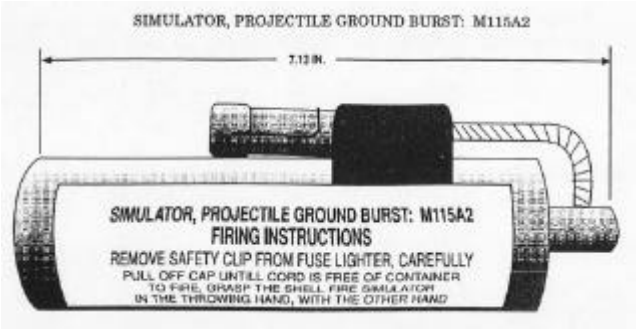
Simulator, Flash, Artillery: M110

USE: Effect battle conditions. Decoy in forward combat areas.

DESCRIPTION: Inner and outer container made of black plastic. Shipped with a commercial squib S93. Uses gasoline in filler hole. Needs a locally fabricated firing tube for discharging of simulator.

FUNCTIONING: Electrically activated. Electric squib ignites pyrotechnic charge and gasoline. **No audible signal. Instantaneous detonation.**

DODAC: 1370-L596



Simulator, Projectile Ground Burst: M115A2

USE: To simulate battle noises and effects.

DESCRIPTION: Cylindrical paper tube, white. Contains a photoflash charge and a whistle assembly. Has a label giving firing instructions attached to the outside of simulator.

FUNCTIONING: Hand-thrown device. Safety fuse provides 6 to 10 second delay. Whistle composition lasts 2 to 4 seconds. **Audible signal. Delayed detonation.**

DODAC: 1370-L594

Remember that these simulators are not interchangeable, do not have the same use, and are not employed in the same manner.

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CALL FOR COLLECTIONS

The Technical Library for Explosives Safety at the Defense Ammunition Center is looking for hardcopy subject collections on explosives, ordnance and ammunition. We will accept books, journals, technical reports, drawings and maps. If you have any, contact Ms. Christine Holiday at (918) 420-8772; DSN 956-8772; e-mail holiday@dac-emh2.army.mil.

ARMY SAFETY TEST MANAGEMENT PROGRAM

The Army Explosives Safety Test Management Program as directed by AR 385-64, 28 Nov 97, Ammunition and Explosives Safety Standards, supports the overall Army Explosives Safety Program. Currently, there are 25 explosives safety test projects which have been identified for improving the explosives safety posture of the U.S. Army. The range of these explosives safety test projects include manufacturing, testing, transportation, maintenance, storage and disposal. Beginning in FY 2001, a funding line has been developed to start some Army test projects.

When these projects are completed, the test results may affect explosives safety policy and/or regulations in one of three ways. First, the test results may validate existing explosives safety policy and/or regulations. In this case, the policy and/or regulations are adequate and no changes are necessary. Secondly, the test results may show a need to establish a new explosives safety policy or regulation. The third possibility may be a need to modify existing explosives safety policy or regulations. The U.S. Army Technical Center for Explosives Safety will utilize the research and test results to enhance U.S. Army explosives safety requirements in AR 385-64 and DAP 385-64. By implementing realistic explosives safety policy and/or regulations based on scientific data, the Army's explosives safety posture will be improved.

Personnel and/or test activities with ideas for explosives safety test projects that may improve the Army's explosives safety program are encouraged to provide them to the following address: Director, Defense Ammunition Center, ATTN: SIOAC-EST, McAlester, OK 74501-9053.

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WHO IS USATCES? WHAT DOES USATCES DO?

The U.S. Army Technical Center for Explosives Safety (USATCES) is the Army's formal center of expertise for explosives and toxic chemical agent safety. USATCES serves as Headquarters, Department of the Army's (HQDA), major commands' (MACOMs), and the ammunition community's focal point of contact for explosives safety. USATCES is located in southeastern Oklahoma on the McAlester Army Ammunition Plant in McAlester, OK.

Explosives safety can have many faces. Explosives safety can involve chemical safety, explosives cleanup, and the classification of different types of explosives. USATCES is an active partner in reducing Army accidents involving explosives. These items can involve ammunition, explosives, or chemical agents either individually or in any combination.

USATCES is involved in the life cycle of ammunition and explosives: from production to use, in peace or in war, including demilitarization, disposal and even the cleanup of contamination left behind. Our goals are to provide assistance and guidance to Army organizations, to help others and to reduce risk. The Army, by definition, needs to maintain mission readiness. Mission readiness saves tax dollars and builds soldiers' confidence that the weapon, ammunition or explosives device they use are the best in the world.

The workforce at USATCES includes a number of disciplines including safety engineers, logistics management specialists, safety and occupational health specialists, librarians, production management specialists, storage specialists and quality assurance specialists (ammunition surveillance) (QASAS). These professionals at USATCES are trained and have experience in dealing with explosives and chemicals from around the world.

Brief History of USATCES

In 1985, Major General Fred Hissong, Jr. was designated to form a team of experts to study 19 explosives accidents at Army ammunition plants. (The number of accidents under study increased to 30 before the conclusion of the study.) Interesting enough, the data gathered revealed two general categories into which further study was warranted: specific accidents and those that identified a systemic problem.

From a need to delve further into the two areas mentioned above, came the conclusion that a single organization did not exist which had as a statement in its charter that it would manage explosives safety. Explosives accidents can cost the Army many millions of dollars a year. The cost of accidents from injury or death to personnel, damages to facilities and equipment, and the adverse impact on mission accomplishment and force protection represented unacceptable losses.

Thus, in February 1988, the Director of Army Staff (DAS) approved an Army wide program to manage Army explosives safety. The Explosives Safety Management Program, established on 4 February 1988 expanded the Army mission through the establishment of the Department of Army Explosives Safety Council (DAESC), Executive Director for Explosives Safety (EDES), and the formation of USATCES.

The Mission of USATCES

The Explosives Safety Management Program assigns USATCES as a technical extension for HQDA to support the overall Army Explosives Safety Management Program.

The USATCES provides assistance and technical services to support and enhance the Army Explosives Safety Management Program. USATCES' responsibilities include, but are not limited to:

- Servicing HQDA and MACOMs worldwide
- Conducting DA Safety Program visits
- Review and act as a final Army approval authority of site and general construction plans
- Provide explosives safety training
- Track explosives safety waivers and exemptions
- Technical support to DA staff
- Establish and maintain an explosives safety database system
- Analyze explosives accident data
- Provide explosives accident investigation assistance
- Track Department of Defense Explosives Safety Board (DDESB) surveys

Additional mission areas have been added to the list in order for USATCES to provide better support to the Army's explosives safety program. In April 1992, Toxic Chemical Agent Safety; October 1992, the Army Hazard Classification; September 1995, Ordnance Explosives Cleanup Safety; and in January 1997, USATCES was selected to provide explosives mishap data support to DOD. In the interim, while the Department of the Army, Office of the Inspector General Technical Inspections Division, has been without a safety and occupational health specialist to conduct chemical surety inspections, USATCES has provided safety augmentees on numerous inspections since 1994. In December 1998, Lieutenant General James W. Link, Deputy Command General of the U.S. Army Materiel Command, tasked USATCES to perform an independent analysis of chemical agent leakers.

USATCES serves a unique role as part of the U.S. Army Industrial Operations Command (IOC) and is a service to the Army worldwide in maintaining safety with explosives, ammunition and toxic chemical agents. USATCES will remain a part of the Army's "protecting the force" plan well into the century.

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NEW HAZARD DIVISION (HD) 1.2 QUANTITY DISTANCE (QD) CRITERIA

The Department of Defense Explosives Safety Board (DDESB) has developed and implemented revised QD criteria for HD 1.2 munitions. Because of the far-reaching implications of this change, DDESB gave the Services until 1 October 2003 to implement the criteria. The revised criteria is very different from the previous version in that "parenthetical" distances have been eliminated. The new criteria will be in Change 1 to DAP 385-64, which is currently awaiting publication. To ease the implementation process, USATCES has developed a guide to the new criteria. This guide can be downloaded from the USATCES web page at the address http://www.dac.army.mil/es. In addition, the DAC Training Directorate has published a training module on the new criteria at the address http://www.dac.army.mil/as/new1.2rules.html. USATCES is now implementing the new criteria in site plans that come in for review.

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DID YOU KNOW?

The Online Computer Library Center (OCLC) FirstSearch service is now available at the Technical Library for Explosives Safety, promising powerful online searching to ensure that library users will have access to the information they need. Designed to make searching simple yet sophisticated enough for all library users, FirstSearch offers options for receiving the full text of journal articles, as well as links to the interlibrary loan service, thereby providing users access to materials from libraries throughout the world.

FirstSearch is a service of the OCLC. Headquartered in Dublin, Ohio, OCLC is a nonprofit, membership, community library service and research organization whose computer network and services link more than 34,000 libraries in 67 countries and territories.

For help with FirstSearch, call us at (918) 420-8772 or DSN 956-8772.

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